

## INFLUENCE OF DIFFERENT HOST PLANTS ON THE BIOLOGICAL CHARACTERISTICS OF THE SEYCHELLARUM MEALYBUG *Icerya seychellarum* (WESTWOOD).

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### ABSTRACT

Laboratory experiments were carried out to study the influence of different host plants on some biological characteristics of *I. seychellarum*. The experiments were conducted in the Insectary of the Economic Entomology Department, Faculty of Agriculture, Mansoura University under fluctuated temperature degrees of  $28 \pm 1^\circ\text{C}$ ;  $20 \pm 1^\circ\text{C}$  and  $60 \pm 5\%$  R.H.

The total developmental stages were the shortest when *I. seychellarum* reared on ornamental palm and represented by  $40.1 \pm 0.71$  and  $54.9 \pm 1.61$  days under fluctuated temperature of  $28 \pm 1^\circ\text{C}$  and  $20 \pm 1^\circ\text{C}$  respectively.

The survival rates during the nymphal stage of *I. seychellarum* was the highest on ornamental palm followed by persimmon and the lowest on mango and guava. Based on the survival rate as an index of suitability of different host plants, the suitability in decreasing order was: on ornamental palm, persimmon, ficus, loquat, guava, mango under fluctuated temperature of  $28 \pm 1^\circ\text{C}$  and  $20 \pm 1^\circ\text{C}$ .

The longest oviposition period, the adult longevity and the highest fecundity of adult females were reared on ornamental palm ( $21.6 \pm 0.41$ ,  $52.7 \pm 0.50$  days and  $63.1 \pm 0.71$  eggs/female) respectively, under fluctuated temperature of  $28 \pm 1^\circ\text{C}$ . On the other hand, the longest oviposition period, the adult longevity and the highest fecundity of adult females when reared on ornamental palm ( $30.8 \pm 0.91$ ,  $71.8 \pm 0.29$  days and  $51.7 \pm 0.38$  eggs/female) respectively, under fluctuated temperature of  $20 \pm 1^\circ\text{C}$ .

### INTRODUCTION

Several mealybug species are pests of different fruit trees and ornamental plants in Egypt (Awadalla 2013).

The seychellarum mealybug, *Icerya seychellarum* (Westwood) is one of the most important mealybug species in Egypt attacking persimmon trees (Ibrahim 2005), guava orchards (El-Sherbenie 2004), mango trees (Abdel-Rahman *et al* 2006 and Abdel-Aleem 2008), mandarin (Awadalla 2013) and ficus trees (Abdel-Mageed 2005 and Ramadan 2011).

The biological characteristics of *I. seychellarum* by rearing either palm leaves or sprouting potatoes under laboratory conditions, annual generations and the ovipositional periods were studied (Abdel-Rahman *et al* 2006 and Abdel-Aleem 2008).

The life span of *I. seychellarum* on ornamental palm under laboratory conditions ranged between 70 and 90 days (Valuli and Kosal 1992). This insect pest had two overlapping generations on mulberry seedlings (Osman

2005) .The scale insect *Ceroplastis floridensis* showed different degrees of preferability to blood orange , loquat and mango leaves (Hodges *et al* 2003 and Abdel-Kareim *et al* 2013) . The chemical analysis of *I. seychellarum* significantly different on crude protein , lipids and total carbohydrates when the insect reared on different host plants , where on the ornamental palm *I. seychellarum* had the highest percentage of crude protein , lipids and total carbohydrates while the lowest crude protein recorded on mango and pomegranate (Awadalla 2015) .

Therefore , the present study has been carried out to obtain more information about the influence of different host plants on the biological characteristics of the seychellarum mealybug *I. seychellarum* under two different temperature degrees .

## MATERIALS AND METHODS

Laboratory experiments were carried out to study the influence of different host plants on some biological characteristics of *I. seychellarum* .The experiments were carried out in the Insectary of the Economic Entomology Department, Faculty of Agriculture, Mansoura University under fluctuated temperature degrees of  $28\pm 1^{\circ}\text{C}$  ;  $20\pm 1^{\circ}\text{C}$  and  $60\pm 5\%$  R.H.

Highly infested leaves from different host plants were selected in the field and transferred to healthy seedlings of different host plants ( persimmon , mango , loquat , guava , ficus and ornamental palm ) . these seedlings were transplanted in pots in the Laboratory . for studying the incubation period , newly laid eggs were isolated from ovipositing females . the ovisacs were carefully kept in Petri-dishes (9 cm diameter ) and kept under the two fluctuated temperatures .

To study the duration period of the nymphal instars under these conditions , newly hatched crawlers were transferred to different host plants seedlings twenty crawlers were used for each host plant. Daily examined for morphological changes were recorded and the nymphal instars for each host plant were calculated . Also , the ovipositional periods , adult longevity and fecundity were recorded for each host plant under the two fluctuated temperature degrees . daily average temperature degree and average relative humidity in the laboratory during the experiments were recorded .

Duration of the developmental stage of the *I. seychellarum* were recorded. Also , the ovipositional periods , adult longevity and fecundity under the two fluctuated temperature degrees were calculated . Moreover survival percentage for the three instars of the nymphal stage of the insect were recorded .

## RESULTS AND DISCUSSION

### 1. Under Insectary conditions of $28 \pm 0.29^{\circ}\text{C}$ :-

#### a- Developmental stages :-

Data presented in Table (1) indicated that , the incubation periods took the same period in all tested host plants (  $8.5 \pm 0.2$  days ) under Insectary conditions of  $28 \pm 0.29^{\circ}\text{C}$  and  $60 \pm 5\%$  R.H. with insignificant differences .

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Data illustrated in Table (1) showed that , the shortest nymphal instars for *I. seychellarum* when reared on ornamental palm and represented by  $8.2 \pm 0.16$  ,  $11.1 \pm 0.18$  and  $12.3 \pm 0.16$  days for 1<sup>st</sup> , 2<sup>nd</sup> and 3<sup>rd</sup> nymphal instars , respectively . while , the longest nymphal instars of *I. seychellarum* when reared on mango and represented by  $8.9 \pm 0.23$  ,  $12.1 \pm 0.34$  and  $13.2 \pm 0.30$  days for the three nymphal instars , respectively . Statistical analysis indicated that , there were a significantly differences according to different host plants for the three nymphal instars of *I. seychellarum* .

As a conclusion , the total developmental stages were the shortest when *I. seychellarum* reared on ornamental palm followed by persimmon and loquat and represented by  $40.1 \pm 0.71$  ,  $40.7 \pm 0.87$  and  $40.8 \pm 0.89$  days with insignificantly differences respectively . On the other hand , the longest developmental periods were recorded on mango and guava and represented by  $42.7 \pm 1.08$  and  $42.1 \pm 0.90$  days , respectively .

The obtained data in Table (2) and Fig.(1) assured that , the survival percentage of the three nymphal instars were the highest on ornamental palm and represented by 89 , 92.1 and 95.1 % , respectively . *I. seychellarum* when reared on persimmon the survival percentage came in the second category and represented by 88 , 90 and 95 % , respectively .

**Table (2) : Survival percentage for the three nymphal instarsof *I. seychellarum* under fluctuated daily temperature degree  $28 \pm 1^\circ\text{C}$  (Range 24 : 33 ) and R.H.  $60 \pm 5$  % on different host plants.**

Host plants	Nymphal stage		
	1 <sup>st</sup> instars	2 <sup>nd</sup> instars	3 <sup>rd</sup> instars
Persimmon	88	90.9	95
Loquat	85	85.8	95.8
Mango	52	94.2	91.8
Guava	69	95.6	92.4
Ficus	79	97.4	93.5
Ornamental palm	89	92.1	95.1

As a conclusion , the survival rates during the nymphal stage of *I. seychellarum* was the highest on ornamental palm followed by persimmon and the lowest on mango and guava . Based on the survival rate as an index of suitability of different host plants , the suitability in decreasing order was : on ornamental palm (78.0 % ) , persimmon (76.0%) , ficus (72.0%) , loquat (70.0%) , guava (61.0%) , mango (45.0%) Fig.(1).

**b- Adult stage :-**

Data arranged in Table (3) revealed that the ovipositional periods of *I. seychellarum* when reared an different host plants under Insectary conditions of  $28^\circ\text{C}$  and  $60 \pm 5$  % R.H. . Pre-oviposition period was the shortest on persimmon and ornamental palm followed by ficus , loquat , mango , and guava with insignificantly differences . on the other hand , the longest oviposition period was on ornamental palm (  $21.6 \pm 0.41$  days ) and the shortest on mango (  $18.2 \pm 0.18$  days ) with significant differences .

**Table (3) : Ovipositional periods , adult longevity and fecundity of *I. seychellarum* under fluctuated daily temperature degree  $28 \pm 1^\circ\text{C}$  (Range 24 : 33 ) and R.H.  $60 \pm 5\%$  on different host plants.**

Ovipositional Periods	Host Plants					
	Persimmon	Loquat	Mango	Guava	Ficus	Ornamental palm
Pre – oviposition	16.8 ± 0.48 a	17.1 ± 0.52 a	17.3 ± 0.63a	17.3 ± 0.64 a	17.0 ± 0.56 a	16.8 ± 0.48 a
Ovi – position	20.9 ± 0.18 a	20.7 ± 0.32 a	18.2 ± 0.18b	19.7 ± 0.10 ab	20.3 ± 0.24 ab	21.6 ± 0.41 a
Inter – oviposition	14.6 ± 0.19 ab	13.8 ± 0.26 b	10.3 ± 0.16 b	13.2 ± 0.18 b	14.0 ± 0.14 ab	15.3 ± 0.33 a
Adult longevity	52.3 ± 0.45 a	51.6 ± 0.43 a	35 ± 0.73 b	40.2 ± 1.38 ab	51 ± 0.29 a	52.7 ± 0.50 a
Fecundity ( No. of egg laying )	59.2 ± 0.18 a	57.6 ± 0.43 ab	40.3 ± 0.21 c	48.6 ± 0.20 b	51.4 ± 0.33 ab	63.1 ± 0.71 a

Means followed by the same letter in a row are not significantly difference at 0.05 level of probability (Duncan's Multiple Range Test).

In respect to , adult longevity was the longest on persimmon and ornamental palm followed by loquat and ficus while , the shortest adult longevity were recorded on mango with significantly differences . moreover , the fecundity was the highest on ornamental palm and persimmon .

As a conclusion , the longest oviposition period , the longest adult longevity and the highest fecundity of the adult females when reared on ornamental palm (  $21.6 \pm 0.41$  ,  $52.7 \pm 0.50$  days and  $63.1 \pm 0.71$  eggs/female ) followed by on persimmon (  $20.9 \pm 0.18$  ,  $52.3 \pm 0.45$  days and  $59.2 \pm 0.18$  eggs/female ) and on loquat (  $20.7 \pm 0.32$  ,  $51.6 \pm 0.43$  days and  $57.6 \pm 0.43$  eggs/female ) , respectively . Meanwhile , the shortest oviposition period , the shortest adult longevity and the lowest fecundity of the adult female when reared on mango and represented by  $18.2 \pm 0.18$  ,  $35.5 \pm 0.73$  days and  $40.3 \pm 0.21$  eggs/female , respectively .

**Fig (1) . Survival percentage for nymphal stage of *I. seychellarum* under fluctuated daily temperature degree  $28 \pm 1^\circ\text{C}$  (Range 24 : 33 ) and R.H.  $60 \pm 5\%$  on different host plants.**

These result are in agreement with those of Valuli and Kosal (1992) , they found that , *I. seychellarum* on ornamental plants in the laboratory the life span ranged between 70 and 90 days . Ibrahim (2005) who found that , *I. seychellarum* reared on persimmon trees the adult longevity was  $51.12 \pm 5.44$  at  $28.6^\circ\text{C}$  while fecundity of female was  $68.2 \pm 4.26$  eggs/female at  $28.6^\circ\text{C}$  Abdel-Rahman *et al.* (2006) mentioned that , *I. seychellarum* can complete its life cycle on mango trees .

**2. Under Insectary conditions of  $20 \pm 0.20^\circ\text{C}$  :-**

**a- Developmental stages :-**

Data presented in Table (4) indicated that , the incubation periods took the same period in all tested host plants (  $15.2 \pm 0.56$  days ) under Insectary conditions of  $22 \pm 0.20^\circ\text{C}$  and  $60 \pm 5\%$  R.H. with insignificant differences .

**Table (4) : Duration period of the developmental stages of *I. seychellarum* under fluctuated daily temperature degree  $20 \pm 1^\circ\text{C}$  (Range 12 : 22 ) and R.H.  $60 \pm 5\%$  on different host plants.**

Developmental stage	Host plants					
	Persimmon	Loquat	Mango	Guava	Ficus	Ornamental palm
Incubation period	$15.2 \pm 0.56a$	$15.2 \pm 0.56a$	$15.2 \pm 0.56a$	$15.2 \pm 0.56a$	$15.2 \pm 0.56a$	$15.2 \pm 0.56a$
<b>Nymphal stage</b>						
1 <sup>st</sup> instar	$10.7 \pm 0.35b$	$10.9 \pm 0.43b$	$11.9 \pm 0.52a$	$11.5 \pm 0.58ab$	$11.2 \pm 0.39ab$	$10.6 \pm 0.35b$
2 <sup>nd</sup> instar	$13.4 \pm 0.29b$	$13.5 \pm 0.31b$	$14.7 \pm 0.51a$	$13.8 \pm 0.36ab$	$13.5 \pm 0.30b$	$13.3 \pm 0.28b$
3 <sup>rd</sup> instar	$16.2 \pm 0.47b$	$16.4 \pm 0.48ab$	$17.8 \pm 0.57a$	$17.3 \pm 0.56a$	$16.8 \pm 0.48ab$	$15.8 \pm 0.42c$
Total nymphal stage	$40.3 \pm 1.11b$	$40.8 \pm 1.22b$	$44.4 \pm 1.60a$	$42.6 \pm 1.50ab$	$41.5 \pm 1.17ab$	$39.7 \pm 1.05b$
Total development stages	$55.5 \pm 1.67b$	$56 \pm 1.78b$	$59.6 \pm 2.16a$	$57.8 \pm 2.06ab$	$55.6 \pm 1.73ab$	$54.9 \pm 1.61b$

Means followed by the same letter in a row are not significantly difference at 0.05 level of probability (Duncan's Multiple Range Test).

Data illustrated in Table (4) showed that , the shortest nymphal instars for *I. seychellarum* when reared on ornamental palm and represented by  $10.6 \pm 0.35$  ,  $13.3 \pm 0.28$  and  $15.8 \pm 0.42$  days for 1<sup>st</sup> , 2<sup>nd</sup> and 3<sup>rd</sup> nymphal instars , respectively . while , the longest nymphal instars of *I. seychellarum* when reared on mango and represented by  $12.9 \pm 0.52$  ,  $14.7 \pm 0.51$  and  $17.8 \pm 0.57$  days for the three nymphal instars , respectively . Statistical analysis indicated that , there were a significantly differences according to different host plants for the three nymphal instars of *I. seychellarum* .

As a conclusion , the total developmental stages were the shortest when *I. seychellarum* reared on ornamental palm followed by persimmon and loquat and represented by  $54.9 \pm 1.61$  ,  $55.5 \pm 1.67$  and  $56.0 \pm 1.78$  days with insignificantly differences respectively . On the other hand , the longest

developmental periods were recorded on mango and guava and represented by  $59.6 \pm 2.16$  and  $57.8 \pm 2.06$  days , respectively .

**Table (5) : Survival percentage of the threenymphal instars of *I. seychellarum* under fluctuated daily temperature degree  $20 \pm 1^\circ\text{C}$  (Range 12 : 22 ) and R.H.  $60 \pm 5\%$  on different host plants.**

Host plants	Nymphal stage		
	1 <sup>st</sup> instars	2 <sup>nd</sup> instars	3 <sup>rd</sup> instars
Persimmon	84	89.2	93.3
Loquat	80	87.5	97.1
Mango	49	85.7	78.5
Guava	69	86.9	90
Ficus	78	88.4	98.5
Ornamental palm	86	90.6	93.5

The obtained data in Table (5) and Fig.(2) showed that , the survival percentage of the three nymphal instars were the highest on ornamental palm and represented by 86 , 90.6 and 93.5 % , respectively for *I. seychellarum* when reared on persimmon the survival percentage came in the second category and represented by 84.0 , 89.2 and 93.3 % , respectively .

**Fig (2) . Survival percentage for nymphal stage of *I. seychellarum* under fluctuated daily temperature degree  $20 \pm 1^\circ\text{C}$  (Range 12 : 22 ) and R.H.  $60 \pm 5\%$  on different host plants.**

As a conclusion , the survival rates during the nymphal stage of *I. seychellarum* was the highest on ornamental palm followed by on persimmon and the lowest on mango and guava . Based on the survival rate as an index of suitability of different host plants , the suitability in decreasing order was : on ornamental palm (73.0%) , persimmon (70.0%) , ficus (68.0%) , loquat (68.0%) , guava (54.0%) , mango (33.0%) Fig.(2).

**b- Adult stage :-**

Data arranged in Table (6) cleared the ovipositional periods of *I. seychellarum* when reared on different host plants under insectary conditions of 22 °c and 60 ± 5 % R.H. . Pre-oviposition period was the shortest on persimmon and ornamental palm followed by ficus , loquat , guava , and mango with insignificantly differences . On the other hand , the longest oviposition period found on ornamental palm ( 30.8 ± 0.91 days ) and the shortest on mango ( 22.3 ± 0.22 days ) with significant differences .

In respect to , adult longevity recorded the longest on ornamental palm followed by on persimmon , loquat and ficus while , the shortest adult longevity recorded on mango with significantly differences . Moreover , the fecundity was the highest on ornamental palm and persimmon .

**Table (6) : Ovipositional periods , adult longevity and fecundity of *I. seychellarum* under fluctuated daily temperature degree 20 ±1°c (Range 12 : 22 ) and R.H. 60 ± 5 % on different host plants.**

Ovipositional Periods	Host Plants					
	Persimmon	Loquat	Mango	Guava	Ficus	Ornamental palm
Pre – oviposition	18.9 ± 0.78 ab	19.2 ± 0.77 a	19.9 ± 0.88 a	19.5 ± 0.28 a	19.1 ± 0.78 ab	18.7 ± 0.71 b
Ovi – position	28.7 ± 0.50 a	27.5 ± 0.25 ab	22.3 ± 0.22 c	25.6 ± 0.45 b	27.3 ± 0.14 ab	30.8 ± 0.91 a
Inter – oviposition	20.3 ± 0.16 ab	20.8 ± 0.17 ab	15.2 ± 0.22 c	18.4 ± 0.41 b	20.4 ± 0.11 ab	22.3 ± 0.39 a
Adult longevity	72 ± 0.27 ab	73.5 ± 0.28 a	72.9 ± 0.26 a	73.7 ± 0.27 a	72.5 ± 0.31 ab	71.8 ± 0.29 b
Fecundity ( No. of egg laying )	48.3 ± 0.20 a	48.1 ± 0.24 a	32.7 ± 0.20 c	40.2 ± 0.21 b	44.6 ± 0.33 ab	51.7 ± 0.38 a

Means followed by the same letter in a row are not significantly difference at 0.05 level of probability (Duncan's Multiple Range Test).

As a conclusion , the longest oviposition period , the longest adult longevity and the highest fecundity of adult females were ( 30.8 ± 0.91 , 71.8 ± 0.29 days and 51.7 ± 0.38 eggs/female ) when reared on ornamental palm followed by persimmon ( 28.7 ± 0.50 , 72.0 ± 0.27 days and 48.3 ± 0.20 eggs/female) and on loquat ( 27.5 ± 0.25 , 73.5 ± 0.28 days and 48.1 ± 0.24 eggs/female ) , respectively . Meanwhile , the shortest oviposition period , the shortest adult longevity and the lowest fecundity of the adult female when reared on mango and represented by 22.3 ± 0.22 , 72.9 ± 0.26 days and 32.7 ± 0.20 eggs/female , respectively .

These result are in agreement with those of Valuli and Kosal (1992) , they found that , *I. seychellarum* on ornamental plants in the laboratory the life span ranged between 70 and 90 days . Ibrahim (2005) who found that , *I. seychellarum* reared on persimmon trees the adult longevity was 64.75 ± 3.63 days at 22.5 °c while fecundity of female was 51.5 ± 5.58 eggs/female at 28.6°c Abdel-Rahman *et al* (2006) mentioned that , *I. seychellarum* can



complete its life cycle on mango trees and mango cultivars are not equally susceptible to *I. Seychellarum* infestation . Abdel-Aleem (2008) suggested that , females of *I. Seychellarum* fed on mango fruits laid more eggs than those fed on branches or leaves . Awadalla (2015) mentioned that , the chemical analysis of *I. seychellarum* significantly differentiated on crude protein , lipids and total carbohydrates when the insect reared on different host plants . *I. Seychellarum* when reared on ornamental palm had the highest crude protein (2.53%) , lipids (12.05%) and total carbohydrates (32.81%) while the lowest crude protein recorded on mango and pomegranate .

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تأثير العوامل النباتية المختلفه على الصفات البيولوجيه للبق الدقيقي السيشلارم  
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التجارب المعملية أجريت لدراسة تأثير العوامل النباتية المختلفة على بعض الخصائص البيولوجية للبق الدقيقي السيشلارم . التجارب أجريت بمعمل الحشرات في قسم الحشرات الاقتصادية , كلية الزراعة – جامعة المنصورة تحت درجات حرارة متغيرة بين  $28 \pm 1^\circ \text{C}$  و  $20 \pm 1^\circ \text{C}$  .  
أوضحت النتائج أن الأطوار غير الكاملة لحشرة البق الدقيقي السيشلارم كانت الأقصر عندما تم تربية الحشرة على أشجار نخيل الزينة حيث كانت  $40.1 \pm 0.71$  و  $54.9 \pm 1.61$  يوماً تحت درجات الحرارة المتغيرة  $28 \pm 1^\circ \text{C}$  ,  $20 \pm 1^\circ \text{C}$  وعلى التوالي .  
أظهرت النتائج أن معدل البقاء خلال طور الحورية للبق الدقيقي السيشلارم كانت الأعلى على أشجار نخيل الزينة يليها على أشجار الكاكي وكانت الأقل على أشجار المانجو والجوافة .  
باعتبار معدل البقاء كمؤشر لملائمة العوامل النباتية المختلفة يمكن ترتيبها تنازلياً كالتالي نخيل الزينة – الكاكي – الفيكس – البشملة – الجوافة – المانجو سواء على درجة الحرارة المتغيرة  $28 \pm 1^\circ \text{C}$  أو  $20 \pm 1^\circ \text{C}$  .  
أطول فترة وضع بيض , أطول فترة حياة للحشرة الكاملة و أعلى كفاءة تناسلية كانت للأنثى البالغة التي تم تربيتها على أشجار نخيل الزينة ( $21.6 \pm 0.41$  ,  $52.7 \pm 0.50$  يوماً و  $63.1 \pm 0.71$  بيضة / الأنثى ) تحت درجة الحرارة المتغيرة  $28 \pm 1^\circ \text{C}$  على التوالي . من ناحية أخرى كانت أطول فترة وضع بيض , أطول فترة حياة للحشرة الكاملة و أعلى كفاءة تناسلية كانت للأنثى البالغة التي تم تربيتها على أشجار نخيل الزينة ( $30.8 \pm 0.91$  ,  $71.8 \pm 0.29$  يوماً و  $51.7 \pm 0.38$  بيضة / الأنثى ) تحت درجة الحرارة المتغيرة  $20 \pm 1^\circ \text{C}$  على التوالي .

**Table (1) : Duration period of the developmental stages of *I. seychelliarum* under fluctuated daily temperature degree  $28 \pm 1^\circ\text{C}$  (Range 24 : 33 ) and R.H.  $60 \pm 5\%$  on different host plants.**

Developmental stage	Host plants					
	Persimmon	Loquat	Mango	Guava	Ficus	Ornamental palm
Incubation period	8.5± 0.2 a	8.5± 0.21 a	8.5± 0.21 a	8.5± 0.21 a	8.5± 0.21 a	8.5±0.21 a
Nymphal stage						
1 <sup>st</sup> instar	8.3±0.22 b	8.3±0.26 b	8.9±0.23 a	8.8±0.24 a	8.7±0.24 a	8.2±0.16 b
2 <sup>nd</sup> instar	11.4±0.23 b	11.4±0.19 b	12.1 ± 0.34 a	11.9 ± 0.23 a	11.8 ± 0.25 a	11.1±0.18b
3 <sup>rd</sup> instar	12.5 ± 0.21ab	12.6 ± 0.23 ab	13.2 ± 0.30 a	12.9 ± 0.22 a	12.8 ± 0.22 a	12.3 ± 0.16 b
Total nymphal stage	32.2 ± 0.66 ab	32.3 ± 0.68 ab	34.2 ± 0.87 a	33.6 ± 0.69 ab	33.3 ± 0.71ab	31.6 ± 0.5 b
Total development stages	40.7 ± 0.87 b	40.8 ± 0.89 b	42.7 ± 1.08 a	42.1 ± 0.90 a	41.8 ± 0.92 ab	40.1 ± 0.71 b

Means followed by the same letter in a row are not significantly difference at 0.05 level of probability (Duncan's Multiple Range Test).